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(54) IDENTIFIER MANAGEMENT

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(51) **Int. Cl.**

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H04L 29/12	(2006.01)
H04L 29/06	(2006.01)

(52) **U.S. Cl.**

CPC ***H04L 61/20*** (2013.01); ***H04L 61/15*** (2013.01); ***H04L 63/00*** (2013.01)

(58) **Field of Classification Search**

CPC G06F 17/5045; H04L 12/4633; H04L 2212/0025; H04L 29/12216; H04L 29/12801

USPC 370/8

See application file for complete search history.

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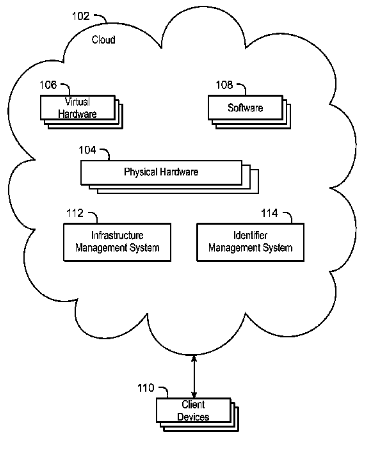
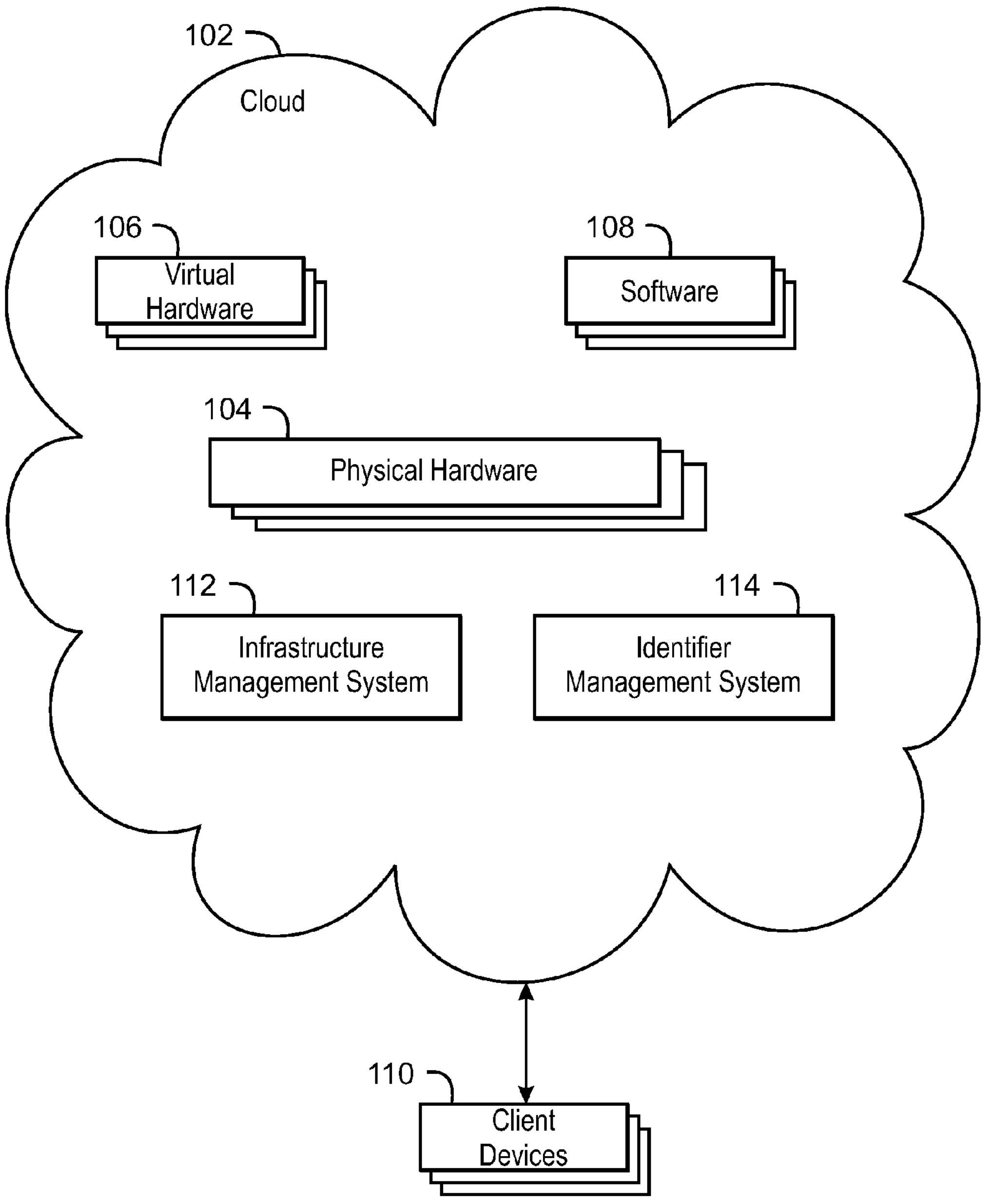
(57) **ABSTRACT**

A method for managing identifiers can include receiving, in an identifier management system, a request for an identifier in a computing system. The method can also include verifying availability of the identifier. The method can further include returning an affirmative response to a requesting party.

20 Claims, 7 Drawing Sheets



100


102
Cloud
106
Virtual Hardware
108
Software
104
Physical Hardware
112
Infrastructure Management System
114
Identifier Management System
110
Client Devices

100

FIG. 1

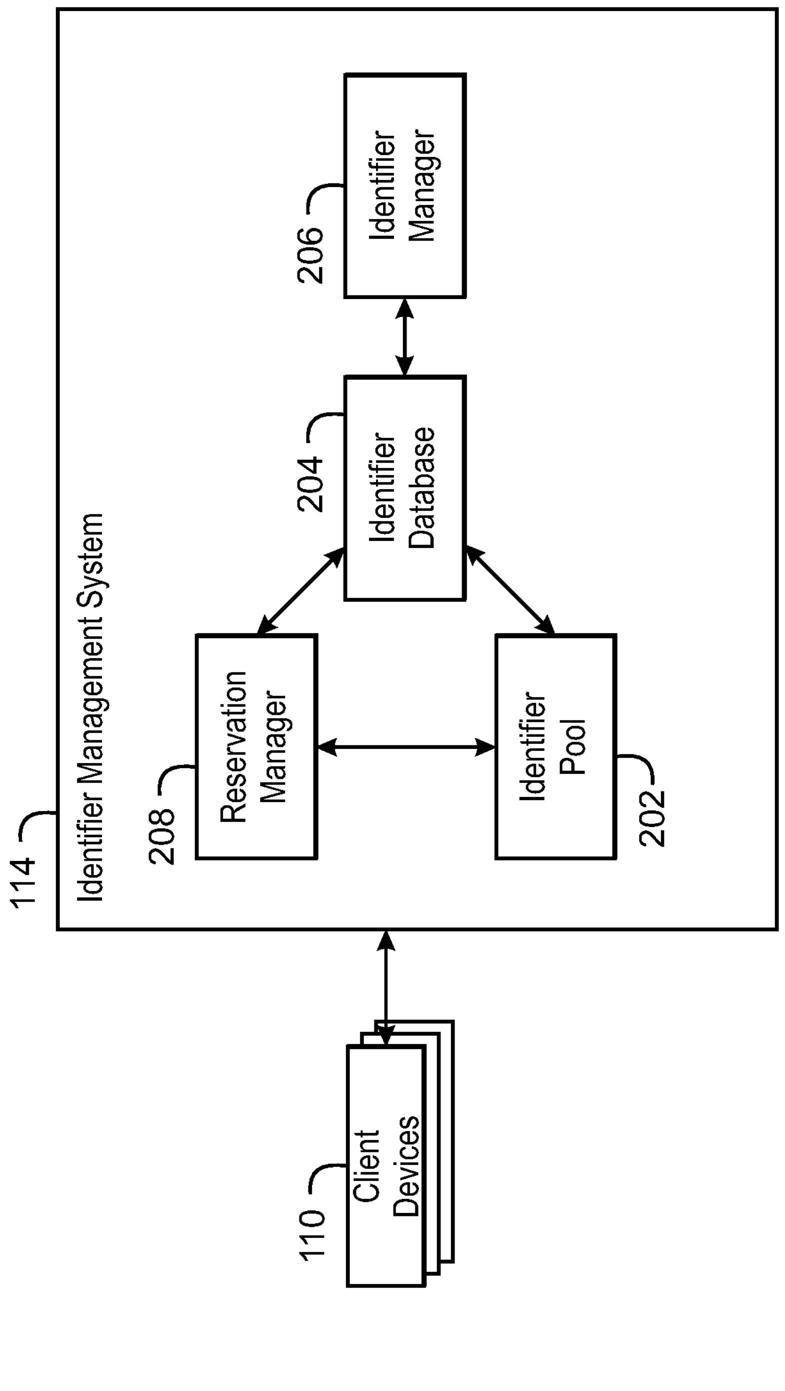
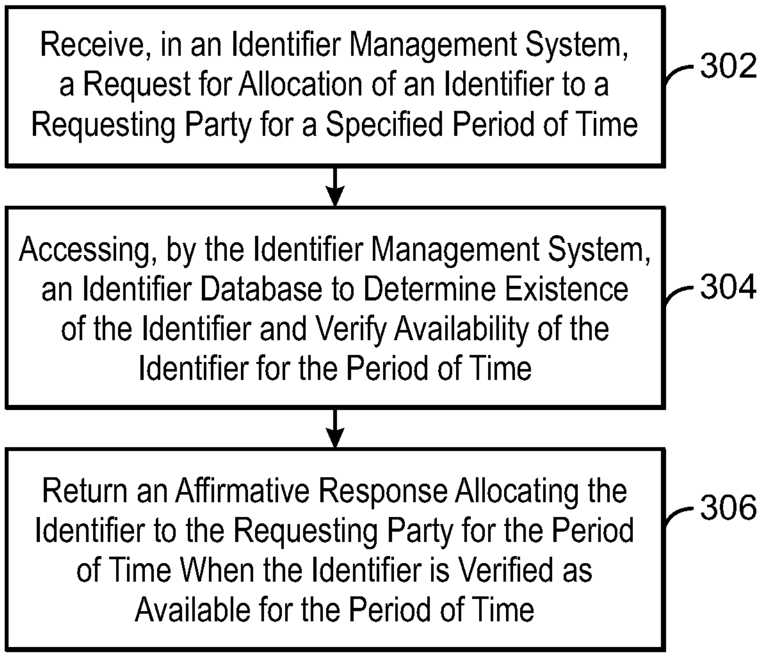
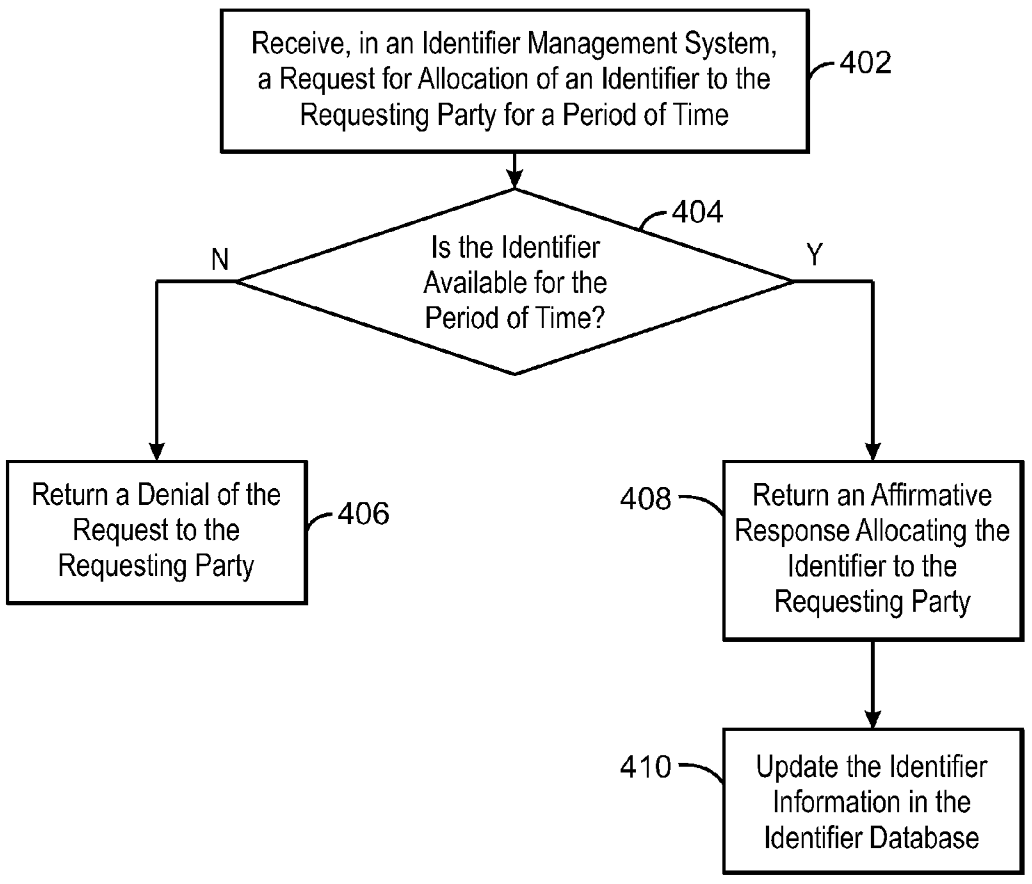

114
Identifier Management System
208
Reservation Manager
204
Identifier Database
206
Identifier Manager
Identifier Pool
202
110
Client Devices

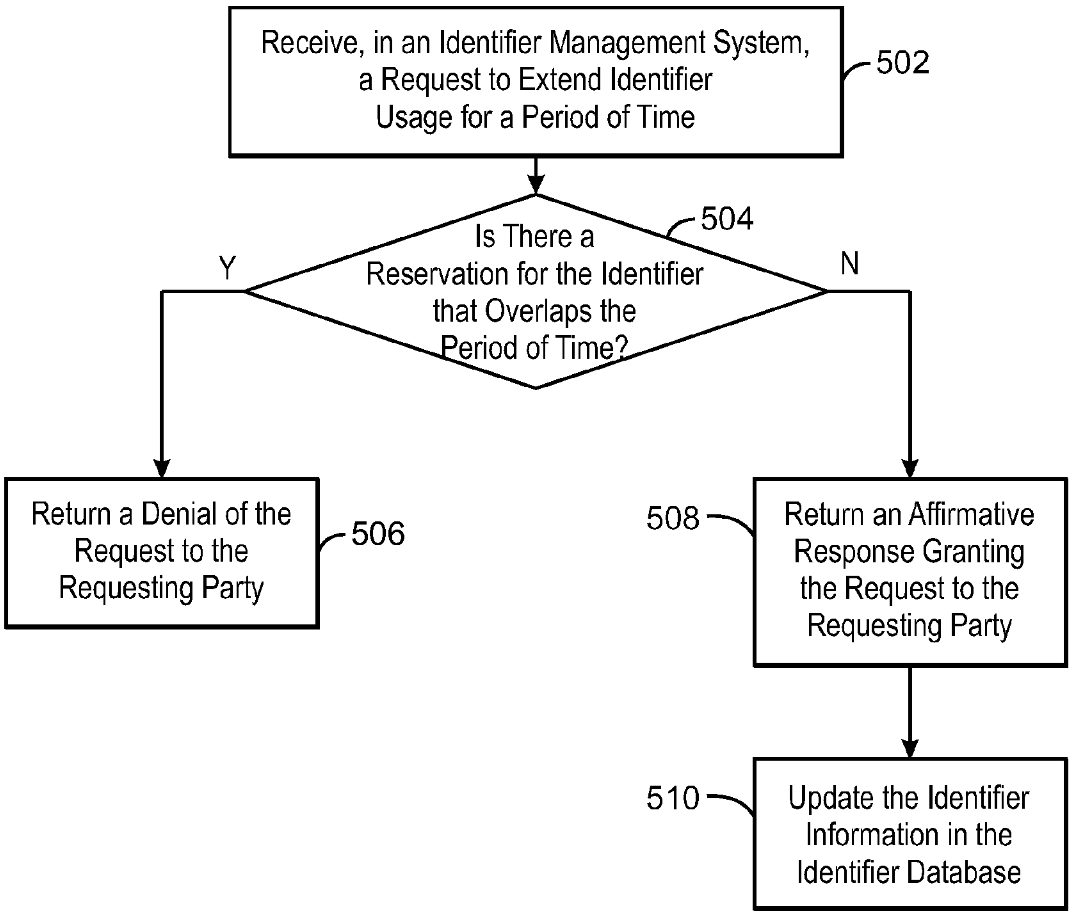
FIG. 2


Receive, in an Identifier Management System, a Request for Allocation of an Identifier to a Requesting Party for a Specified Period of Time
302
Accessing, by the Identifier Management System, an Identifier Database to Determine Existence of the Identifier and Verify Availability of the Identifier for the Period of Time
304
Return an Affirmative Response Allocating the Identifier to the Requesting Party for the Period of Time When the Identifier is Verified as Available for the Period of Time
306

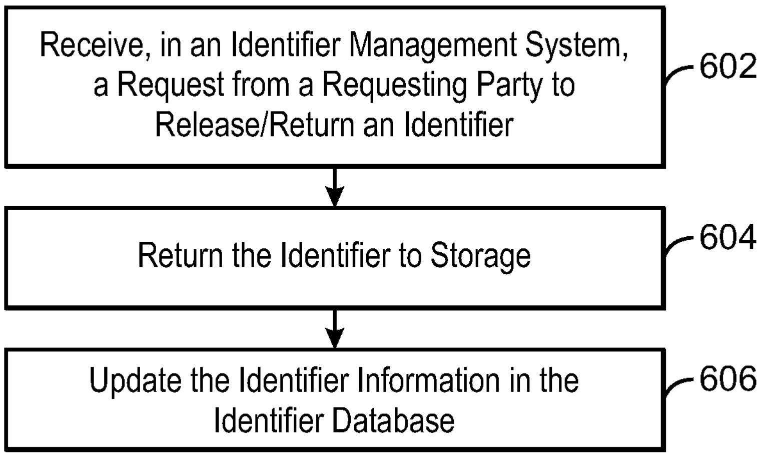
300
FIG. 3


Receive, in an Identifier Management System, a Request for Allocation of an Identifier to the Requesting Party for a Period of Time
402
Is the Identifier Available for the Period of Time?
404
N
Y
Return a Denial of the Request to the Requesting Party
406
408
Return an Affirmative Response Allocating the Identifier to the Requesting Party
410
Update the Identifier Information in the Identifier Database

400
FIG. 4


Receive, in an Identifier Management System, a Request to Extend Identifier Usage for a Period of Time
502
Is There a Reservation for the Identifier that Overlaps the Period of Time?
504
Y
N
Return a Denial of the Request to the Requesting Party
506
508
Return an Affirmative Response Granting the Request to the Requesting Party
510
Update the Identifier Information in the Identifier Database

500
FIG. 5


Receive, in an Identifier Management System, a Request from a Requesting Party to Release/Return an Identifier
602
Return the Identifier to Storage
604
Update the Identifier Information in the Identifier Database
606

600
FIG. 6

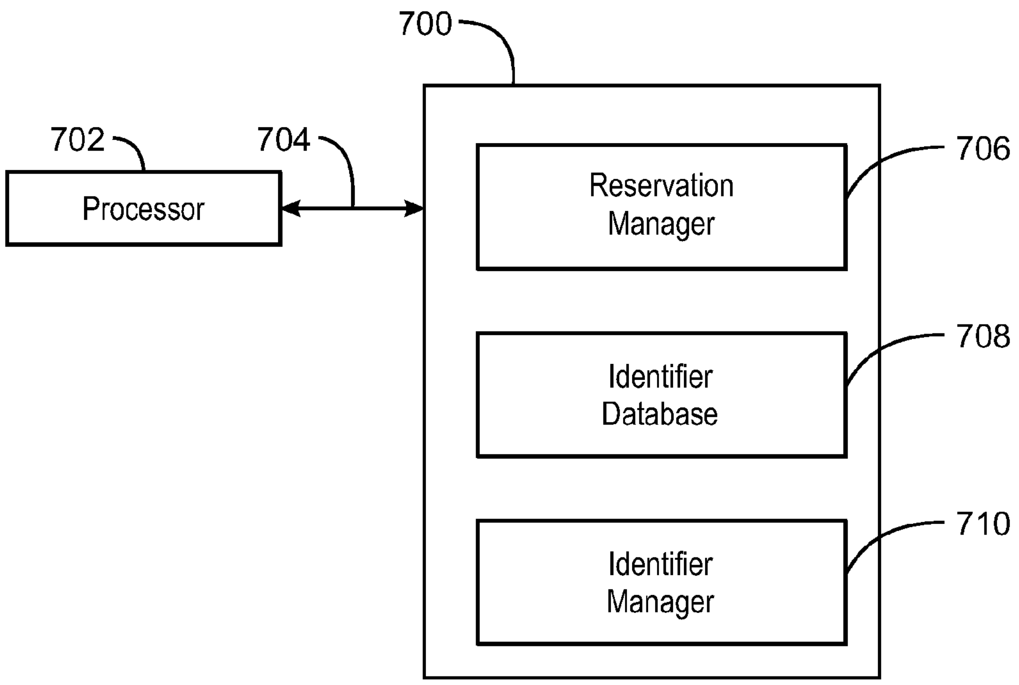

700
702
704
Processor
Reservation Manager
706
Identifier Database
708
Identifier Manager
710

FIG. 7

IDENTIFIER MANAGEMENT

BACKGROUND

Information Technology (IT) systems, such as cloud computing systems, include a variety of identifiers, such as license keys and IP addresses. These identifiers can be allocated to a device upon request. Allocation of identifiers to devices can be tracked by a system engineer.

BRIEF DESCRIPTION OF THE DRAWINGS

Certain exemplary embodiments are described in the following detailed description and in reference to the drawings, in which:

FIG. **1** is a block diagram of an example of a cloud computing system with an identifier management system;

FIG. **2** is a block diagram of an example of an identifier management system;

FIG. **3** is a process flow diagram of an example of a method of managing identifiers in a computing system;

FIG. **4** is a process flow diagram of an example of a method of managing identifiers in a computing system;

FIG. **5** is a process flow diagram of an example of a method of managing identifiers in a computing system;

FIG. **6** is a process flow diagram of an example of a method of managing identifiers in a computing system; and

FIG. **7** is a block diagram of an example of a system for managing identifiers in a computing system.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

Embodiments disclosed herein provide techniques for managing identifiers in an IT system. The term "identifier" refers to an arbitrary string of a predetermined fixed maximum length meant to describe a piece of information to install or configure a system. Examples of identifiers can include domain name system (DNS) Host names, virtual local area network (VLAN) tags, IP addresses, virtual machine names, logical unit number (LUN) names, license keys, etc. An identifier can be prepopulated (i.e., created before a request for the identifier is made) or the identifier can be generated in response to a request, and can be limited or unlimited.

In today's operations, system engineers maintain a number of identifiers. The identifier information is typically maintained in spreadsheets, or as a well structured machine usable form. However, while the existence of the identifier is managed, the lifecycle of the identifier is not managed. The lifecycle of the identifier includes creation, deletion, allocation, release, and re-use of the identifier. Lifecycle information is used in manual provisioning cycles, even if an automated system is used to perform the provisioning. As a result, provisioning occurs with human intervention/contribution and is subject to error, as well as being time consuming and introducing delays. Because of the dependence of provisioning on human intervention, a provisioning system cannot be completely automated.

An automated identifier management system can be introduced to define, store, report, and manage lifecycles of identifiers. The identifiers can be maintained in a generalized form of strings with an associated type that discriminates the use of the identifier. For example, an identifier "345" can be attributed a type of VLAN tag and the string 345 can be attributed with a type of an access list number. Often, identifiers cannot exist in duplicate in the same context. For example, VLAN ID 345 cannot exist twice in the same layer-2 network. The identifier management system maintains a state for identifiers so that the identifier is not in use twice at the same time, but can be re-used once released from a previous use.

By introducing an identifier management system, identifier maintenance can be automated and human maintenance of identifiers can be eliminated. The identifier management system can be integrated with workflow systems and other automation systems, providing a fully automated service for identifier provisioning. As a result, multiple entities can be provisioned with a single provisioning request, the element of human error is removed, and delays are reduced or eliminated.

FIG. **1** is a block diagram of an example of a cloud computing system with an identifier management system. The cloud computing system **100** can be a public system, a community system, a hybrid system, a private system, or some combination of systems. In an example, a cloud computing system **100** includes a cloud **102** including a combination of physical hardware **104**, virtual hardware **106**, and software **108**. The cloud computing system **100** also includes a client **110**. The cloud computing system **100** may include a single client device **110** or multiple client devices **110**. The client device **110** can be a desktop computer, a laptop computer, a tablet computer, a cellular phone, such as a smartphone, or any other suitable device. The client device **110** can be coupled to the cloud **102** via a wired connection or a wireless connection. In an example, the client device **110** is coupled to the cloud **102** via an Ethernet connection, a WLAN connection, a LAN connection, or any other suitable connection method. In an example, the cloud **102** receives service requests from a client **110** and returns a service result to the client.

A cloud computing system **100** is a system in which multiple pieces of hardware and software are utilized over a network to perform specific computing tasks. The combination of physical hardware **104**, virtual hardware **106**, and software **108** is often referred to as the cloud **102**. The cloud symbol is often used to represent the abstraction of a network.

Physical hardware **104** can include processors, memory devices, and networking equipment, among others. The physical hardware **104** performs the actual computing and processing required by the cloud computing system **100**. For example, the physical hardware **104** performs a computation requested by a client device **110**.

Virtual hardware **106** is a type of software that is processed by physical hardware **104** but is designed to emulate a specific set of hardware. For example, a particular piece of software is designed to be run by a specific type of hardware. By running virtual hardware **106** on top of the physical hardware **104**, a given piece of hardware can run software designed for many different types of hardware.

Software **108** can be defined as a set of instructions and data configured to cause a processor to perform specific processes. These processes can be used for running applications which are made available to an end user. Software is designed to operate with specific hardware architecture. Hardware architecture can indicate the format of the processor instructions. Thus, one benefit of using virtual hardware is that multiple different hardware components can all operate the same software.

The physical hardware **104**, virtual hardware **106**, and the software **108** associated with the cloud can be configured to receive service requests from a client device **110**. The cloud computing system **100** can then perform the desired processes and return the result to the client device **110**.

The cloud computing system **100** can also include an infrastructure management system **112**. The infrastructure management system **112** is responsible for managing the computing identifiers of the cloud computing system **100**. For example, infrastructure management system **112** creates new virtual hardware **106** emulated by physical hardware **104** and installs software **108** on either physical hardware **104** or virtual hardware **106**.

The cloud computing system **100** further includes an identifier management system **114**. The identifier management system **114** is an electronic management system that tracks the identifiers of the computing system **100** and records lifecycle information pertaining to the identifiers. The identifier management system **114** also receives requests for identifiers from the client **110** and determines if an identifier is available for allocation to the client **110**.

While the computing system **100** is illustrated as a cloud computing system, it is to be understood that the computing system **100** is not limited to cloud computing systems and can include any suitable type of computing system. It is to be understood that the block diagram of FIG. **1** is not intended to indicate that the computing system **100** is to include all of the components shown in FIG. **1** in every case. Further, any number of additional components can be included within the computing system **100**, depending on the details of the specific implementation.

FIG. **2** is a block diagram of an example of an identifier management system **114**. The identifier management system **114** can be an electronic system designed to operate automatically without depending on a human operator. The identifier management system **114** includes an identifier pool **202**. The identifier pool includes a plurality of identifiers of the computing system. For example, the identifier pool can include product keys for a variety of products, DNS host names, VLAN Tags, IP Addresses, etc. Identifiers can be pre-propagated (i.e., created before a request is made for the identifier) or an identifier can be created in order to fulfill a request for the identifier. As such, the identifier pool may not include all of the identifiers of the computing system. For example, the identifier pool can include all pre-propagated identifiers, but not include identifiers created to fulfill a particular request.

The identifier management system **114** also includes an identifier database **204**. The identifier database stores all information about each of the identifiers in a computing system. The information can include lifecycle information of each identifier, including creation, deletion, allocation, release, and re-use, as well as any additional information about each identifier.

The identifier database **204** is managed by an identifier manager **206**. The identifier manager **206** updates the identifier information in the identifier database **204** whenever a change is made to an identifier. For example, the identifier manager **206** can automatically update the identifier database **204** when a change to the lifecycle of an identifier is detected. By updating the identifier database **204** whenever a change is made to an identifier, the state of a particular identifier at any given time is known.

The identifier management system **114** additionally includes a reservation manager **208**. The reservation manager **208** receives requests from a client **110** for an identifier. The request can be a request for a particular identifier or the request can be for any available identifier of a particular type. The request includes the period of time for which the identifier is to be used. The reservation manager **208** accesses the identifier database **204** to determine if the identifier exists and is available for the period of time. If the identifier is available for the period of time, the reservation manager **208** returns an affirmative response to the client **110**, assigning the identifier to the client **110** for the requested period of time. If the identifier is not available for the period of time, for example, if a previous reservation of the resource for part or all of the period of time is in the identifier database **204**, a denial of the request is returned to the client **110**.

For example, a client **110** can request a license key for a piece of software. The reservation manager **208** can access the identifier database **204** to determine if a license key for the software exists and is available. If a license key is available, the reservation manager **208** can assign the license key to the client **110** for the period of time listed in the request. For example, a product key can be included in a pool of available product keys that are assigned as a request to access the identifier is granted. The identifier database **204** can be updated when the license key is assigned to the client **110**. In another example, a license key can be created "on-the-fly" in response to a reservation and deleted when the reservation ends, or recycled as a reservation ends and a new reservation is activated. The identifier database **204** is updated when the license key is created, updated again when the license key is assigned to a client **110**, and updated yet again when the license key is deleted or recycled. In an example, a limited number of license keys can exist for a particular piece of software. When all of the license keys are assigned to clients **110**, a request to access the identifier is denied until a license key becomes available. A license key can become available when a reservation period ends or when a client **110** sends a request to return/release an identifier before the reservation period ends.

It is to be understood that the block diagram of FIG. **2** is not intended to indicate that the identifier management system **200** is to include all of the components shown in FIG. **2** in every case. Further, any number of additional components can be included within the identifier management system **200**, depending on the details of the specific implementation.

FIG. **3** is a process flow diagram of an example of a method of managing identifiers in a computing system. The method can begin at block **302** with receiving, in an identifier management system, a request for an identifier. The identifier can be any type of identifier, such as a product key, a DNS Host name, a VLAN tag, an IP Address, a Virtual Machine Name, a LUN name, or any other type of identifier. The request can include the length of time for which the identifier is requested.

At block **304**, the identifier management system can verify availability of the identifier. In order to verify the identifier availability, the identifier management system can access an identifier database. The identifier database stores information about the lifecycle of each identifier in the computing system. The information includes creation, deletion, allocation, release, and re-allocation of the identifiers.

At block **306**, the identifier management system can return a response to the requesting party. If the identifier is available, an affirmative response is returned to the requesting party. If the identifier is not available, a denial of the request is returned to the requesting party.

It is to be understood that the process flow diagram of FIG. **3** is not intended to indicate that the method **300** is to include all of the components shown in FIG. **3** in every case. Further, any number of additional blocks can be included within the method **300**, depending on the details of the specific implementation.

FIG. **4** is a process flow diagram of an example of a method of managing identifiers in a computing system. The method **400** can begin at block **402** with receiving, in an identifier management system, a request for an identifier for a period of time. The identifier can be any type of identifier, such as a product key, a DNS Host name, a VLAN tag, an IP Address, a Virtual Machine Name, a LUN name, or any other type of identifier.

At block **404**, the identifier management system can determine if the identifier is available for the period of time. In order to determine availability of the identifier, the identifier management system can access an identifier database. The identifier database stores information about the lifecycle of each identifier in the computing system. The information includes creation, deletion, allocation, release, and re-allocation of the identifiers. The identifier database is updated whenever a change is made to an identifier in the computing system.

If the identifier is not available for the period of time, at block **406** a denial of the request can be returned to the requesting party. If the identifier is available for the period of time, at block **408** an affirmative response can be returned to the requesting party, assigning the identifier to the requesting party for the requested period of time. At block **410**, the identifier information in the identifier management system can be updated to reflect the assignment of the identifier to the requesting party.

It is to be understood that the process flow diagram of FIG. **4** is not intended to indicate that the method **400** is to include all of the components shown in FIG. **4** in every case. Further, any number of additional blocks can be included within the method **400**, depending on the details of the specific implementation.

FIG. **5** is a process flow diagram of an example of a method of managing identifiers in a computing system. The method **500** can begin at block **502** with receiving, in an identifier management system, a request to extend identifier usage for a period of time.

At block **504**, the identifier management system can determine if there is a reservation for the identifier that overlaps the period of time. In order to determine if there is a reservation for the identifier, the identifier management system can access an identifier database.

If there is a reservation that overlaps the period of time, at block **506** the identifier management system can return a denial of the request to the requesting party. If there is not a reservation that overlaps the period of time, at block **508** an affirmative response can be returned to the requesting party. At block **510**, the identifier information in the identifier management system can be updated.

It is to be understood that the process flow diagram of FIG. **5** is not intended to indicate that the method **500** is to include all of the components shown in FIG. **5** in every case. Further, any number of additional blocks can be included within the method **500**, depending on the details of the specific implementation.

FIG. **6** is a process flow diagram of an example of a method of managing identifiers in a computing system. The method **600** can begin at block **602** with receiving, in an identifier management system, a request to release/return an identifier. A requesting party can request to release/return an identifier for any suitable reason.

At block **604**, the identifier can be returned to storage. The identifier can be returned to storage until the identifier is re-assigned in response to a new request. In this way, identifiers can be recycled. Alternatively, an identifier can be deleted upon return/release. For example, an identifier generated in response to a request can be deleted upon release of the identifier by the requesting party. At block **606**, the identifier information in the identifier management system can be updated. For example, the identifier information can be

updated to indicate the release of the identifier and the availability of the identifier for re-allocation or deletion of the identifier.

It is to be understood that the process flow diagram of FIG. **6** is not intended to indicate that the method **600** is to include all of the components shown in FIG. **6** in every case. Further, any number of additional blocks can be included within the method **600**, depending on the details of the specific implementation.

FIG. **7** is a block diagram of an example of a system for managing identifiers in a computing system. The tangible, non-transitory, computer-readable medium is referred to by the reference number **700**. The tangible, non-transitory, computer-readable medium **700** can comprise RAM, a hard disk drive, an array of hard disk drives, an optical drive, an array of optical drives, a non-volatile memory, a universal serial bus (USB) drive, a digital versatile disk (DVD), or a compact disk (CD), among others. The tangible, non-transitory, computer-readable medium **700** can be accessed by a processor **702** over a computer bus **704**. Furthermore, the tangible, non-transitory, computer-readable medium **400** can include code configured to direct the processor **702** to perform the methods described herein.

As shown in FIG. **7**, the various components discussed herein can be stored on the non-transitory, computer-readable medium **700**. A first region **706** on the tangible, non-transitory, computer-readable medium **700** can include a reservation manager for managing requests for identifiers. A region **708** can include an identifier database for storing information identifier lifecycle information. A region **710** can include an identifier manager to manage the identifier database and the information therein. Although shown as contiguous blocks, the software components can be stored in any order or configuration. For example, if the tangible, non-transitory, computer-readable medium **700** is a hard drive, the software components can be stored in non-contiguous, or even overlapping, sectors.

It is to be understood that the block diagram of FIG. **7** is not intended to indicate that the storage medium **700** is to include all of the components shown in FIG. **7** in every case. Further, any number of additional components can be included within the storage medium **700**, depending on the details of the specific implementation.

While the present techniques may be susceptible to various modifications and alternative forms, the exemplary examples discussed above have been shown only by way of example. It is to be understood that the technique is not intended to be limited to the particular examples disclosed herein. Indeed, the present techniques include all alternatives, modifications, and equivalents falling within the true spirit and scope of the appended claims.

What is claimed is:

1. A method for managing identifiers, comprising:

receiving, in an electronic identifier management system, a request for allocation of an identifier to a requesting party for a specified period of time;

accessing, by the identifier management system, an identifier database to determine existence of the identifier and verify availability of the identifier for the period of time; and

returning an affirmative response allocating the identifier to the requesting party for the period of time when the identifier is verified as available for the period of time.

2. The method of claim **1**, further comprising:

receiving, in the identifier management system, a request to extend identifier usage for a time period;

checking, by the identifier management system, the identifier database for reservations for the identifier that overlap the time period; and

returning a response to the requesting party.

3. The method of claim **2**, wherein the response is an affirmative response granting the request when no reservations overlap the time period and the response is a denial of the request when a reservation overlaps the time period.

4. The method of claim **1**, further comprising:

receiving, in the identifier management system a request to return an identifier; and

returning an identifier to storage for re-allocation.

5. The method of claim **4**, wherein the identifier comprises a product key, a license key, a domain name system (DNS) Host name, a virtual local area network (VLAN) tag, an IP address, a virtual machine name, a logical unit number (LUN) name, or a combination thereof.

6. The method of claim **1**, wherein the computing system is a cloud computing system.

7. An electronic system for identifier management, comprising:

a reservation manager to manage a request from a client for an identifier and to verify availability of the identifier;

a database to store lifecycle information of identifiers in a computing system; and

an identifier manager to manage the database,

wherein upon receiving the request from the client, the reservation manager accesses the database to verify availability of the identifier and returns to the client a response to the request based on the information received from the database.

8. The system of claim **7**, wherein the lifecycle information comprises creation, deletion, allocation, release, re-allocation, or a combination thereof of an identifier.

9. The system of claim **7**, wherein the identifier manager automatically updates the database when a change is made to an identifier.

10. The system of claim **7**, wherein the identifier is one of a domain name system (DNS) Host name, a virtual local area network (VLAN) tag, an IP address, a virtual machine name, a logical unit number (LUN) name, or a license key.

11. The system of claim **7**, wherein the reservation manager accesses the database to determine availability of the identifier.

12. The system of claim **7**, wherein the reservation manager returns an affirmative response granting the request when the identifier is available and the reservation manager returns a denial of the request when the identifier is not available.

13. The system of claim **12**, wherein when the reservation manager returns an affirmative response, the identifier manager updates the identifier database to reflect allocation of the identifier to a requesting party for a requested period of time.

14. The system of claim **7**, wherein the identifier management system manages identifiers in a cloud computing system.

15. A tangible, non-transitory, computer-readable storage medium, comprising code for identifier management that, when executed, causes a processor to:

receive a request for assignment of an identifier to a requesting party for a specified period of time;

access an identifier database to determine existence of the identifier and verify availability of the identifier for the period of time; and

return an affirmative response allocating the identifier to the requesting party for the period of time when the identifier is verified as available for the period of time.

16. The tangible, non-transitory, computer-readable storage medium of claim **15**, wherein the response is an affirmative response granting the request when the identifier is available for the period of time and the response is a denial of the request when the response is not available for the period of time.

17. The tangible, non-transitory, computer-readable storage medium of claim **15**, wherein the code further causes the processor to:

receive a request from the requesting party to extend identifier usage for a time period;

check the identifier database for reservations for the identifier that overlap the time period; and

return a response to the requesting party.

18. The tangible, non-transitory, computer-readable storage medium of claim **17**, wherein the response is an affirmative granting the request when no reservations overlap the period of time and the response is a denial of the request when a reservation overlaps the period of time.

19. The tangible, non-transitory, computer-readable storage medium of claim **15**, wherein the code further causes the processor to:

receive a request from the requesting party to return an identifier; and

return the identifier to storage.

20. The tangible, non-transitory, computer-readable storage medium of claim **19**, wherein the identifier is re-allocated in response to a new request for the identifier.

* * * * *